PATENT

IN THE

UNITED STATES PATENT AND TRADEMARK OFFICE

ART UNIT 2675

Examiner Srilakshmi Kumar

IN THE PATENT APPLICATION OF Gary B. Gordon, et al.

CASE: 10980359-6

SERIAL NO: (unknown, this is a continuation of 09/052, 046)

FILED: 2 January 2000

SUBJECT: "SEEING EYE" MOUSE FOR A COMPUTER SYSTEM

THE COMMISSIONER OF PATENTS AND TRADEMARKS
WASHINGTON, D.C. 20231

SIR:

(PRELIMINARY) AMENDMENT "B"

In timely response to a Final Office Action mailed in the above-captioned Parent Patent Application on 7 November 2000, which set a three month shortened statutory period for response expiring 7 February 2001, and for which a continuation has been filed in accordance with 37 CFR 1.53(b), please amend the Application as requested below.

In The Claims

☞ Please **cancel** Claims 1-12 (being the originally filed claims of the parent case) and enter in their place new claims 16 - 22 as written below:

16. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a desktop surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of non-coherent illumination mounted within the interior of the housing, proximate the aperture, that illuminates, from a single location and with an angle of incidence in the range of about five to twenty degrees, a portion of the desktop surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated, the highlights and shadows forming a pattern that varies as a function of rotations and translations of the aperture relative to the desktop;

an optical motion detection circuit mounted within the interior of the housing and optically coupled to the highlights and shadows from the surface height irregularities of the illuminated portion of the desktop surface, the optical motion detection circuit producing motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the desktop surface; and

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to ascertain motion in the directions along the first and second axes.

17. A hand held pointing device as in claim 16 wherein the optical coupling is performed by a lens.

18. A hand held pointing device as in claim 16 wherein the optical coupling is performed by a mirror.

19. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and optically coupled to the pattern of highlights and shadows from the surface height irregularities of the illuminated portion of the work surface, the optical motion detection circuit producing motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output

values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to produce a corresponding plurality of correlation values and ascertain motion in the directions along the first and second axes; and

an arithmetic comparison mechanism coupled to the plurality of correlation values, and wherein the motion signals are not output to the computer system whenever a correlation surface described by the plurality of correlation values fails to exhibit a selected curvature.

20. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and optically coupled to the pattern of highlights and shadows from the surface height irregularities of the illuminated portion of the work surface, the optical motion detection circuit producing motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to produce a corresponding plurality of correlation values and ascertain motion in the directions along the first and second axes; and

an arithmetic comparison mechanism having inputs coupled to the motion signals and wherein the motion signals are not output to the computer system whenever the motion signals indicate a velocity that exceeds a preselected limit.

21. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and optically coupled to the pattern of highlights and shadows from the surface height irregularities of the illuminated portion of the work surface, the optical motion detection circuit producing

motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to produce a corresponding plurality of correlation values and ascertain motion in the directions along the first and second axes; and

a switch disposed on the skirt in a location underneath the right thumb or the left ring finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit and that inhibits the output of the motion signals to the computer system when the hand activates the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface.

22. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of

shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and optically coupled to the pattern of highlights and shadows from the surface height irregularities of the illuminated portion of the work surface, the optical motion detection circuit producing motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to produce a corresponding plurality of correlation values and ascertain motion in the directions along the first and second axes; and

a switch disposed on the skirt in a location underneath the left thumb or the right ring finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit and that inhibits the output of the motion signals to the computer system when the hand activates the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface.

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REMARKS

The Specification has, in the parent case, previously been reviewed for typographical and grammatical errors, and appropriate corrections were requested in earlier responses. At present, applicants are unaware of any further errors. The present Specification supplied with the filing papers in the instant case incorporate fixes for all known errors, and does not otherwise contain any new matter, although it has also been adjusted to include the recitation of co-pendency required by 35 USC 120. The parent case received a Final Rejection, and an Amendment Under Rule 116 was filed in that case to bring an allowable claim (7, objected to as dependent upon a rejected claim) to issue. As for the balance of the claims under final rejection in the parent case, the present case is a continuation of that parent, and this (Preliminary) Amendment "B" is essentially a preliminary amendment that is in response to the Final Action in the parent case (paper #7) that was mailed 7 November 2000.

In the Final Action of the parent case claims 1-15 were pending, of which 13-15 were allowed, 5-7 were objected to, while 1-4 and 8-12 were variously finally rejected. Subsequent to the mailing of applicants' response of 22 August 2000 (received on 25 Aug. and to which paper #7 was in reply), applicant became aware of an issued U.S. patent (5, 894, 302 to Scenna) that might have been of interest to the Examiner regarding certain ones of the allowed claims. That patent, as well as others mentioned in the August response have been incorporated into an Information Disclosure Statement accompanying this paper (Amendment B) and the filing under Rule 53(b). In brief, the remaining existing claims have been canceled in favor of newly drafted claims 16-22 whose patentability over all the cited references is argued below.

The lens element recited in earlier claims has, in claim 16, been replaced by "optical coupling" included in the recitation of the optical motion detection circuit. A lens (lines 21-23 on page 10 of the Specification, and in earlier claims, all as originally filed) is certainly an instance of optical coupling. In new dependent claim 17 the optical coupling is again recited as a lens, and in new dependent claim 18 it is recited as a mirror. Antecedent support for this may be found in the incorporated Patent to Allen (U.S. 5, 578, 813) @ 9:31 - 37 and in his Figure 4. The beam splitter 37 has mirror properties as part of its beam splitting ability. Therefore, claims 16-18 are believed to contain no new matter regarding their present respective recitations of "optical coupling," "lens" and "mirror."

In the remarks that follow it is convenient to employ the following convention to refer to an area of interest within the text of a patent. For example, if we were supporting the notion that Nestler does not

recognize gray regions, we could refer to lines 26-29 of col. 6 in Nestler as "Nestler @ 6:26-29" (col. # : ln. #'s).

We shall first consider claim 16, with traverses of Nestler (U.S. 4, 799, 055) combined with Gordon (U.S. 5, 786, 804), then of Allen (U.S. 5, 578, 813) and finally of Jackson (U.S. 4, 794, 384). New claims 17 and 18 are dependent upon claim 16, and deal with optical coupling of the motion detector to the illuminated work surface. Following that, we shall consider claim 19, briefly mention claim 20 (corresponds to an allowed claim), and then lastly consider claims 21-22 and Scenna (U.S. 5, 894, 302).

The salient features of Nestler are these: He discloses an optical mouse intended for navigation upon surfaces not having any predetermined pattern thereon. His point of departure is with the prior art he mentions (1:36-41). At 1:45-67 he characterizes that prior art thusly:

> "... these ... devices disadvantageously require a work surface or pad, which has a defined or predetermined pattern of light and dark areas or colors, in order to operate...."; "is ... pattern sensitive, which means, that the internal processing algorithms therein for determining movement, have been defined for the particular predetermined pattern ..."; and, "If these patterns get dirty or otherwise have irregularities in them, the optical mouse devices will not operate efficiently or effectively. Moreover, if for some reason the patterned surface is unavailable to the user, the optical device will become inoperable."

To Nestler, a "pattern" is produced by "light or dark areas or colors" (1:47-48). He wants to make his mouse "pattern insensitive" (2:4) so that a "random surface pattern (of) [sic] relatively light and dark areas separated by edges ..." (2:6-8) is all that his mouse needs to navigate upon. Nestler gives us an idea of what surfaces he has in mind, when he says @ 2:8-10 "...for example, a wood grained surface or any surface that is not completely monochromatic with no image imperfections thereon."

What is common to the two notions the previous prior art's "predetermined pattern" and Nestler's "random surface pattern" is that they both have light and dark areas, and ***that they are part of the surface***. Clearly they are part of the surface in the case of the predetermined pattern; they had to be put there to determine the pattern in the first place. There is nothing in Nestler that leads us to believe that they are not still part of the surface in the random case. Consider his example of wood grain. It is indeed random in the sense that you have to see it to know what it is (it cannot be accurately anticipated in any detail). But if we rotate the surface a quarter of a turn clockwise, we certainly perceive a corresponding rotation in the pattern, which means that the pattern is part of the surface. Continuing in this line of thought, we note that if the pattern includes a component made of colors, then the same relationship obtains: if there is relative translation or rotation between the observer and the surface, then the pattern appears to experience that same motion.

We note further that the surface could be monochromatic but have variations in albedo (inherent reflectivity or absorption), which would then appear as light and dark areas that would exhibit this same correlation of movement for rotation and translation. This may seem unremarkable, but we should none the less identify why this is so. **IT IS BECAUSE THE PATTERN IS A FIXED PROPERTY OF THE SURFACE, AND NOT A FUNCTION OF THE DIRECTION FROM WHICH THE SURFACE IS ILLUMINATED!!!**

Consider a surface whose only interesting feature is that it has a micro-texture arising from surface roughness, and ignore for the moment the existence of any color or albedo variations. Let the surface be, for example, a desktop. Now illuminate the desktop with a grazing angle of illumination, and ask if there is a pattern that can be perceived. The illumination will produce a random pattern of highlights and shadows. Now let the observer and the source of illumination remain in a fixed relative spatial relation (e.g. stationary) and then rotate the desktop relative to the fixed relative spatial relation of the observer and the light source. Does the pattern remain the same, and merely rotate? ALMOST CERTAINLY NOT!! The reason is that the particular highlights and shadows (illuminated and non-illuminated portions of the micro-texture) that obtain are indeed functions not only of the surface, **but also of the direction from which they are illuminated.** To see this, suppose the micro-texture were of mounds or pinnacles that project upwards from an ideal plane into the light to produce highlights. Suppose they are also narrow along one axis (X) and wide along the other (Y). Then the sizes and shapes of the individual highlights depend upon whether the light is coming from the X direction or the Y direction. That is, grazing illumination striking a wider upward projection will create a wider highlight and a wider shadow behind. But as the direction of illumination changes, that which appears wide may change to appear narrow. A similar thing happens for the shape of the shadows, which are regions of blocked illumination. These changes in size and shape for shadows and highlights constitute a change in the shape of the pattern that they form.

Translation changes the shape of the pattern as well, although the effect may not be as pronounced. Nevertheless, shadows will be longer when they are further away from the source of illumination, and shorter when they are closer. Highlights will likewise be affected. **These changes in size for shadows and highlights also constitute a change in the shape of the pattern that they form.**

The example set out just above appears to rely on an asymmetry of the upward projections to produce the variable shape pattern of shadows and highlights. This is not so, and we picked an asymmetrical example only to help establish the idea of such a variable pattern. Upon reflection, it will be appreciated that the micro-texture can be both symmetrical (rods of square or circular cross section, cones, spherical domes) and regularly spaced, and it can still (and in most cases will) produce a pattern of highlights and shadows that

form a pattern which varies as a function of the location from which the micro-texture is illuminated with grazing illumination. It is true that for a fixed range of grazing illumination one can insist on projections having a circular symmetry about an axis normal to the surface, and pick a large spacing between projections, such that the pattern of shadows and highlights seems not to change shape under selected relocations of the source of grazing illumination, but appears to rotate as if it were a fixed pattern. These (and some others) are contrived extreme "corner" cases that are not at all representative of typical micro-texture. But even in such contrived cases, translations will still vary the length of shadows as the changing distance from a projection to the light source is accompanied by a slight change in the angle of incidence.

On the other hand, ordinary micro-texture is likely to be **irregular** as to size, shape and location of its individual features, even if those sizes, shapes and locations each contribute to average values that seem to characterize the micro-texture as a whole. Such irregularity is not necessary, but is certainly sufficient (and its presence **is** quite typical), to ensure the formation of a pattern that varies in shape. That variation in shape might itself be regular or irregular; that does not matter. The point is that the shape of the pattern of highlights and shadows is not static. We can be quite confident that when run of the mill micro-texture in the range of five to five hundred microns is struck by grazing illumination, it will produce highlights and shadows that form a pattern which varies as a function of the location of the illumination. By the phrase "varies as a function of the location of the illumination" we mean not merely that a first pattern segment disappears from view as a different second pattern segment appears from an opposite side during translation, and that the different segments are distinguishable while the middle region stays unchanged even while moving. (That is what you would see through an aperture as that aperture is slid across a surface having a fixed pattern thereon.) Instead, we mean that each highlight and each shadow in the pattern thereof is undergoing a change in size and or shape as the relative movement proceeds. The recited size range for the micro-texture features excludes any presumed "nano-texture" at the atomic level of individual atoms or molecules.

THEREFORE, IN THE CASE OF PATTERNS OF HIGHLIGHTS AND SHADOWS PRODUCED FROM GRAZING ILLUMINATION OF MICRO-TEXTURE, A RESULTING PATTERN **<u>IS NOT</u>** SOLELY A FIXED PART OF THE SURFACE, BUT IS A FUNCTION ALSO OF THE DIRECTION FROM WHICH THE ILLUMINATION IS APPLIED TO THAT SURFACE. WE NOTE ALSO, THAT IF ONE WANTS TO PRODUCE SUCH A PATTERN OF HIGHLIGHTS AND SHADOWS, <u>THE SURFACE SHOULD NOT BE SIMULTANEOUSLY ILLUMINATED FROM DIFFERENT DIRECTIONS</u>, AS THIS DIMINISHES THE CONTRAST BETWEEN THE SHADOWS AND HIGHLIGHTS IN FAVOR OF EXPANDED UNIFORM DIFFUSE ILLUMINATION, WHICH IN

THE LIMIT IS A FULLY ILLUMINATED SURFACE WITH NO SHADOWS OR ISOLATED HIGHLIGHTS. IN SUCH A CASE OF "FULL" ILLUMINATION VARIATIONS IN SURFACE ABSORPTION AND REFLECTIVITY CAN STILL AFFECT QUANTITIES OF REFLECTED LIGHT REACHING AN IMAGING PLANE TO ALLOW THE SHAPE OF THE SURFACE TO BE SEEN, BUT NOW THE VISIBLE PATTERN OF FEATURES FOR THAT SURFACE **IS** A FIXED PART OF THAT SURFACE (IDENTICAL TO ITS SHAPE), AND THAT PATTERN ONCE AGAIN TRANSLATES AND ROTATES WITHOUT CHANGE (WE DON'T THINK OF THE SHAPE OF SOMETHING AS CHANGING WHEN WE TRANSLATE IT OR ROTATE IT).

Now consider claim 16. It recites in part:

> 16. A hand held pointing device ... comprising:
>
> a housing having a bottom surface that moves against a desktop surface;
>
> ...
>
> an aperture in the bottom surface;
>
> a source of non-coherent illumination mounted within the interior of the housing, proximate the aperture, that illuminates, from a single location and with an angle of incidence in the range of about five to twenty degrees, a portion of the desktop surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and shadows upon surface height irregularities that extend into the desktop surface and whose illumination is blocked by adjacent surface height irregularities that are illuminated, the highlights and shadows forming a pattern that varies as a function of rotations and translations of the aperture relative to the desktop;
>
> an optical motion detection circuit ... optically coupled to the highlights and shadows from the surface height irregularities of the illuminated portion of the desktop surface [and] producing motion signals indicative of motion ... relative to the surface height irregularities of the illuminated portion of the desktop surface; and
>
> wherein the optical motion detection circuit comprises ... to ascertain motion in the directions along the first and second axes.

It will be noted at the outset that the claim recites a desktop surface (essentially a work surface) and non-coherent illumination. We will come back to the import of these limitations later. For now, and with regard to Nestler, it is the balance of the source of illumination limitation that is principally of interest. This element in the claim positively and expressly recites a number of features that cooperate to produce a pattern of highlights and shadows that is more than just a fixed part of, or attribute of, the surface being navigated upon. ***The claimed pattern is also a function of the position of the source of illumination relative to the portion of the surface being illuminated.***

This comes about from these things in the claim: First, the illumination comes from a single location (there is one source). This avoids the "filling in" of shadows with other light, and an accompanying overabundance of less pronounced highlights arising from diffuse illumination. There can be no shadows if the illuminated region is "one big highlight" produced from multiple light sources. Next, the illumination is recited as having a specific range for angle of incidence, which is that for the "grazing" illumination described in the Specification. The desktop surface is further recited as having surface height irregularities of a specific range of sizes (again, taken from the Specification). Surface height irregularities that extend out of the desktop and that intercept the illumination are recited as producing highlights, while shadows are recited as being formed by surface height irregularities that extend into the desktop and whose illumination is blocked by adjacent surface height irregularities that are illuminated. ***An important consequence of this is that the pattern of highlights and shadows produced by the illumination is not static under relative translations and rotations, but changes (from one pattern to another) as the individual highlights and shadows are altered by differing aspects of the irregular micro-texture becoming illuminated and blocking illumination.*** This feature is recited as "...the highlights and shadows forming a pattern that varies as a function of rotations and translations of the aperture relative to the desktop".

None of these above-mentioned features of claim 16 are shown or suggested by Nestler. NOWHERE in Nestler is there any suggestion whatsoever of **micro-texture that is illuminated with a grazing angle of incidence** (the recited range of about five to twenty degrees) to produce the recited pattern of highlights and shadows that varies as a function of rotations and translations of the aperture relative to the desktop. Now we look closely at Nestler to see what he does say, the better to understand that it is not, nor does it suggest, what is claimed.

The relevant passages in Nestler are these:

I	(2:3-10)	"... i.e., can operate on virtually any substantially planar imperfect surface, especially those having a random surface pattern [of] (sic) relatively light and dark areas separated by edges, for example a wood grained surface or any surface that is not monochromatic with no image imperfections thereon."
II	(2:18-20)	"... is movable on a surface having a pattern of relatively light and dark areas separated by edges ..."
III	(2:23-24)	"... means for optically sensing motion on any random surface pattern with edges ..."
IV	(3:32-34)	"... on a surface having any random surface pattern of relatively light and dark areas separated by edges ..."
V	(5:56-58)	"Disposed in alignment with aperture 7 is optics 8 which receives light reflected from the surface 6 from light sources, 4, 5 onto photoelectric sensors ..." (See also Figures 1A and 1B, and note that there are indeed two light sources in two different locations.)

As for passages I-IV, it is clear that Nestler means a "surface pattern" having a pattern of relatively light and dark areas that is an inherent part of the surface itself. One example he gives is that of a wood grained surface. We do not expect that the direction of the grain in a piece of wood will be a function of which way the light is coming from. Nor would we expect a pattern of color variations in some other work surface to be altered by the direction of illumination. ***Nestler <u>never</u> mentions the <u>creation</u> of a pattern through the act of illumination!*** The pattern he is interested in <u>is there ahead of time</u>, so to speak. He never mentions any existence of shadows on the surface, nor of highlights, either.

In these passages he talks of "edges" separating the areas of light and dark. What are we to make of that; does it suggest highlights and shadows? He does occasionally talk of white or dark objects (4:18-19), a white area (4:38), bright spots (7:34) and white or dark objects (8:51-52). However, it is rash, and an impermissible re-construction of Nestler in light of applicants' teachings to conclude that Nestler shows or suggests the production of the claimed highlights and shadows by grazing illumination from a source at a single location.

First, Nestler teaches that the surface may be multi-colored (in I: "... or is any surface that is not monochromatic ..."). It is not unusual for color variations to be caused by compositional variations in material that are abrupt, and that therefor appear to be separated by edges. These colored regions may also appear light and darker either because: (1) they absorb and reflect differently; and/or (2) the spectral response of the optical sensor has a sloped sensitivity curve relative to applied wavelength. This is sufficient to account for light or dark spots/areas/objects.

Now consider the remaining case and suppose Nestler's surface is monochromatic. We assume that it is not altogether featureless, or there would be nothing to navigate on. We note that he does say (in I) "...imperfect surface..." and "... image imperfections ...". Applicants will again stipulate that Nestler's work surface almost certainly has some kind of micro-texture, even though he never talks about it. Does this mean Nestler shows or suggests the navigation on highlights and shadows produced by that inherent micro-texture? Once again the answer is "NO" because what "...imperfect surface..." and "... image imperfections ..." mean is that the inherent shapes of those surface features produce a visible ***fixed pattern***, but <u>without</u> the claimed highlights and shadows that produce a ***variable pattern as a function of the location of the illumination***.

An example readily shows how this can be so. Consider a garden variety computer keyboard. The one this is being typed on appears to be made of plastic of some uniform color, save for the lettering, which is either paint or inlaid regions of darker plastic. Ignore the lettering; it will not be part of the example. Let the keyboard be located in an office setting with diffuse overhead (ceiling) illumination. Turn off any nearby desk lamps, and allow no direct sunlight to fall on the keyboard. The keys themselves have slightly concave top surfaces that are to receive the fingertips. Surrounding these top surfaces are sides. There is an abrupt edge where the sides meet the top, and other edges between the sides. There are edges and the bottoms of the keys, too. Can all this be seen? Certainly. It is fair to say that there is a visible pattern associated with the keyboard? Of course. But is it a pattern of highlights and shadows that varies with the direction of illumination? Rotate the keyboard upon the desktop and see what happens. Does the visible pattern you perceive as your keyboard change? ***No. It changes hardly any, if at all, except that it rotates the same as the keyboard.*** It is true that the crevices between the keys are less well illuminated than the tops, and the crack between the surrounding bezel and the field of keys is a pretty dark region. ***But it also stays that way when the keyboard is rotated!*** (It might become hidden behind an obstructing key in your line of sight; but it is still there to be seen if you but move your head.) The same goes for the edges: they are visible and they don't move around to morph the shape of the keyboard as it is rotated. The image of the keyboard (which has been playing the role of micro-texture on some work surface) is an unchanging pattern that is a fixed

property of the surface, and not of the direction from which it is illuminated with a source in a single location. Read on.

Now take that keyboard into a completely dark room. Shine a grazing beam of light from a flashlight on it from some distance away. The image of the keyboard will probably be recognizable as such, but will now include highlights and shadows. Have an assistant hold the flashlight and then rotate the keyboard, and note that the pattern formed by the highlights and shadows varies according to the rotation (which is equivalent to moving the light source). The long rectangular keys (Space bar, Enter key, Backspace key, Shift key, etc.) contribute pattern elements that behave differently than those for the more symmetrical keys. But even the pattern elements originating with the more symmetrical keys vary as a function of translation and rotation.

Note that in passage V Nestler describes multiple light sources (in the plural!) and shows two light sources in each of his Figures 1A and 1B. This, and the utter absence of any other described mode of illumination in Nestler mean that his illumination is diffuse, and corresponds to the example of the keyboard in the well lit office. This is both consistent with what Nestler teaches and it accounts for how he can get the results he says obtain. We have thus removed the temptation to reconstruct Nestler using applicants's own teachings, since we have shown that Nestler operates without benefit of applicants' teachings. What applicants claim is altogether different (as in the example of the keyboard in the dark, with grazing illumination and a ***changing pattern of highlights and shadows***) and <u>is not</u> shown or suggested by Nestler.

Nor does the combination of Gordon with Nestler show or suggest the claimed invention. As mentioned in the previous response, Gordon does not create highlights and shadows from illuminated micro-texture. He has no source of illumination, relying instead on diffuse ambient illumination within, say a room. He merely maps the image of a scene onto the photo-detectors, and image corresponds to the fixed shapes of the items in the scene; rotate Gordon's device relative to the scene and the pattern that is the scene merely rotates in return. We appreciate that Gordon was cited to show other features in the claimed combination, having to do with frames and correlation. But since neither Nestler nor Gordon provide the claimed "... highlights and shadows forming a pattern that varies as a function of rotations and translations of the aperture relative to the desktop ..." the earlier rejection under 35 USC 103 over Nestler in view of Gordon is believed to have been overcome by claim 16.

We turn now to Allen, wherein is disclosed a handheld scanner that uses two navigation sensors to keep track of the path of an image sensor over a document being scanned. The navigation sensors are each similar to or the essentially the same as applicants' recited optical motion detection element in claim 16. These

navigation sensors are each responsive to grazing non-coherent light applied from an associated single location (9:9-37, 9:63-10:10 and Figure 5). Allen navigates on paper, although he also mentions cardboard, fabric and human skin (10:2-3). He never mentions navigating on the surface of a desktop. Allen et al. were intent on making a portable handheld scanner of documents; who wants to scan the top of his desk? His scanner was not contemplated as also functioning as a mouse (*that* patent was filed *after* this case was), so whether or not the navigation would work on a desktop was not of interest. Paper, especially if it is not glossy, was pretty well understood. In words of a reference (Holland, 5,089,712 @ 3:34-43) cited against Allen:

> "Operation of the position-detecting sub-system of FIG. 1 is generally based upon the fact that blank white paper is not, in fact, uniform when viewed at high magnifications, e.g., at magnifications of about 300 pixels per inch. The non-uniformities that are observed at such magnifications are ordinarily due to the presence of fibers, such as wood and/or cloth fibers, in paper sheets. In fact, when a paper sheet is viewed at such magnifications, fibers in the sheet have a wavy, grass-like appearance without uniform width or color."

At the time that Allen et al. were inventing they were all co-workers at Hewlett-Packard with Holland, and were aware of his work. In fact, they set out to take advantage of it. A "wavy, grass-like appearance without uniform width or color" is a rich texture to navigate upon, entirely sufficient for scanning purposes. Desktops were not only uninteresting as not being a suitable target for scanning, it is not clear that the wide variety of surfaces (real wood, fake wood, formica, paint, etc.) would lend themselves to the navigation technique that had been developed to that time. Somebody had to try it to find out if it would even work. The present inventors did that, and were pleasantly surprised. It is true that Nestler wants his mouse to navigate on an arbitrary surface, including a wood grained one, but his technique involves diffuse lighting and is responsive to the fixed patterns that are inherently part of the surface. (Remember, the terms "with the grain" and "across the grain" refer to conditions that are inherently part of a piece of wood, and not to how is it viewed or illuminated.) The is not the same thing as navigating with grazing illumination on a desktop having a micro-texture that produces "highlights and shadows forming a pattern that varies as a function of rotations and translations of the aperture relative to the desktop" as is claimed. It wasn't obvious that the navigation technique developed for wavy grasslike texture would work on surfaces (plastic "fake wood") not having an abundant fiber content.

Allen has not to this point been applied. While it is appropriate that it be cited, it is believed that the claims comply with 35 USC 103 in regard to Allen, and that Allen should remain unapplied.

We turn now to Jackson. His technique is based on the phenomenon of speckle, which arises from interference of reflected **coherent light** with itself (Jackson @ 3:55 - 4:14). Furthermore, it is clear from what he says there that the surface imperfections he relies on are "... on the order of half a wavelength ..." Even for the longest infrared wavelengths (a check of handbooks and device catalogs puts the longest peak response wavelength at about 1100 nanometers, or 1.1 microns) that half wavelength is about .6 microns. **Applicants' smallest claimed feature size for micro-texture is five microns, or over eights times larger.** Jackson uses these small imperfections to produce speckle, which he describes at 4:22-46. Speckle is not equivalent to the claimed highlights and shadows. A speckle patten has light are dark regions arising from reflected light, but the dark regions are not the absence of reflected light due to blocked illumination (as in the claimed shadows); **they are dark because of cancellation through interference that occurs at the optical detector.**

We have three arguments to make concerning speckle. The first is easiest to appreciate, and is that the imperfections that produce speckle are about a half-wavelength in size, and that even for the longest wavelength IR devices, those largest of Jackson's features are smaller than 1/8 the smallest of the features in applicants' claimed micro-texture. Therefore, navigation is not performed upon the same kinds of surfaces. The second argument is that the light and dark regions in a speckle pattern are not the claimed highlights and shadows. Simply put, the claimed intercepting and blocking of non-coherent light makes reflected highlights and their associated shadows, while both light and dark regions within a speckle pattern arise from interference that is only created at the optical detector by coherent light that has been reflected; non-reflected light does not contribute to the dark regions in speckle!

The third argument concerns angle of incidence. It turns out that speckle works best when the coherent illumination is applied nearly normal to the surface, while applicants' claims recite a grazing angle of illumination. To support this argument, we refer to five paragraphs of a US Patent to Ivey et al., (5, 793, 357) cited in Jackson, and also mentioned extensively by Jackson in his Background. With apologies for this lack of brevity, here below are five paragraphs of interest from Ivey @ 5:28 -6:11:

> FIG. 17 shows a typical intensity profile through a laser spot, reflecting off a 'rough' surface. Here, rough means not optically flat. Constructive and destructive interference causes the intensity profile to vary, giving rise to the well known laser speckle effect. Because laser speckle is generated by random undulations in the illuminated surface, the speckle itself is random in nature. ***It should be noted that the relationship between speckle and surface features is not a simple one to one contour map, but every part of the resulting speckle image depends upon every part of the illuminated surface. A change in part of the surface under the spot could therefore cause the entire speckle pattern to change.*** (Emphasis added).

Speckle is visible on a rough surface regardless of the angle of incidence of the light. The angle of incidence does, however, appear to be an important factor in producing a usable pattern. While the angle of incidence of the light source is near to the surface normal, the speckle pattern clearly follows the underlying motion of the surface relative to the detector. ***If the angle of incidence is shallow, however, while pattern motion is visible, it is somewhat obscured by a noise component in the image.*** (Emphasis added).

While the angle at which the illuminated surface is viewed by the detector does not appear to be critical, ***it has been found that many advantages can be gained by viewing in the same plane as the source.*** (Emphasis added). FIG. 8 shows one arrangement of the illumination/detection components by which this can realised, with the light source 80 directed through a semi-reflective mirror 81 on to the surface 82, the light scattered back from the surface being reflected by the semi-reflective mirror 81 on to the detector 83.

As the illuminated surface moves relative to the laser source and detector, the speckle pattern also moves. Part of the moving speckle pattern results from reflection off the surface in areas continuously under the spot during movement (towards the middle of the spot), while a second component arises from reflections off areas of the surface that either move under the spot, or move out from under the spot during movement (at the periphery of the spot). FIG. 18 illustrates this.

Speckle from the centre of the spot 167 appears to move coherently with respect surface movement, providing a means of tracking the surface, while speckle created by the periphery of the spot 168, appears more random in nature, adding 'dither' to the overall speckle image. If a large spot is used, the central area contributes a much larger amount to the speckle image than does the peripheral spot region (the ratio increasing with radius) resulting in mostly coherently moving speckle. Where a very small spot is used, the speckle appears to change mostly randomly with movement, and it is difficult to extract movement in this case.

Note that according to Ivey a "moving" speckle image cannot be expected to merely translate according to the relative motion between the work surface and the motion detector. According also to Jackson (@4:50-57): "... The speckle pattern not only moves, ***but transforms*** (emphasis added), since the illuminated surface itself changes due to the translatory motion between the source 12 and surface 14. Thus a new portion of surface 14 becomes illuminated as an older portion of the surface moves from the view of array 16 and is no longer illuminated and, therefore, ***the speckle pattern changes, since (from Ivey) "... It should be noted that the relationship between speckle and surface features is not a simple one to one contour map, but every part of the resulting speckle image depends upon every part of the illuminated surface. A change in part of the surface under the spot could therefore cause the entire speckle pattern to change ...".*** (Emphasis added). We can now see that "the speckle pattern changes" does not mean the edges change as the motion occurs while the center stays the same. Unless some precautions are taken, the whole pattern changes dramatically and abruptly, and the technique becomes a scientific curiosity. Those precautions include the angle of incidence and plane of observation requirements emphasized in the above quoted passage from Ivey. **Note that the angle of incidence requirement is contrary to the oblique illumination that is claimed by applicants.** Clearly,

highlights and shadows are best created by shallow angles (what applicant termed 'oblique' illumination in the Specification, and 'grazing' illumination in the incorporated Specification of Gordon), and highlights and shadows are least apparent when the angle of illumination near to the surface normal, which is what Ivey says works best.

There is yet another (a fourth) way to appreciate that speckle is not equivalent to the claimed highlights and shadows of oblique illumination. Consider that a motion detector has, just as ones own eye would, a field of view. Let "the line of sight" of the detector be normal, or nearly so, to the surface it is looking at. Ordinarily that field of view would be described by a conical shape that expands in diameter as the distance to the work surface from the detector (eye) increases along the line of sight. There is nothing strange here, and it merely means that if the work surface were a little further away the area viewed would increase some. If the work surface were illuminated obliquely to produce highlights and shadows, then more of the pattern thereof would become visible, as expected. But the central portion of the pattern itself would not change as the point of view moved in or out; the pattern is strongly correlated to the surface imperfections that produced it and to the location of the light source relative to those imperfections. The central part of the pattern that remains visible **does not change** as a peripheral edge of the pattern is added or deleted by varying the distance along the line of sight. Varying the location of the optical detector along its line of sight resembles the notion of a fixed pattern that is part of the illuminated surface, which after all, is where the illumination occurs. (Note that in this example we are **not** moving the source of illumination relative to the surface!)

Contrast that with speckle, which is an interference phenomenon. It takes place not just at the work surface (reflection) but also at the detector (the interference). Interference is a variable phenomenon that takes place at distances that are on the order of the wavelength of the light used. Clearly the interference patterns (the speckle) change as a function of distance between the work surface and the detector, and changes on the order of wavelengths will be significant. Thus, we can expect a speckle pattern to vary over its entirety as a function of minor changes in distance (wavelengths of light!), which is to say, very abruptly, **which is behavior not exhibited by the claimed highlights and shadows! The recited change in shape of the claimed highlights and shadows occurs at a scale of motion comparable to the size of the features producing them, which even at it smallest is a lot larger than wavelengths of light. Thus, the recited change in shape of the claimed highlights and shadows is not abrupt like it is for speckle, and the claimed highlights and shadows are, in yet another way, different from speckle patterns.**

On the basis of the argument offered above, the claims are believed to comply with 35 USC 103 as regarding Jackson.

The reason for the limitations of non-coherent light and for the surface being navigated upon being a desktop can now be appreciated. A desktop is recited to reflect the inventive discovery that the recited navigation technique of grazing illumination of micro-texture to produce highlights and shadows that form a pattern that varies as a function of the location of a single source of illumination actually does work, and that the embedded fibers of Allen were not required. Non-coherent light is recited to help in distinguishing over the speckle technique of Jackson and Ivey.

Claim 19 corresponds to allowed claim 7 in the parent case, and re-appears here in a somewhat modified form that comports with new independent claim 16. Claim 19 is not presently believed in need of argumentative support.

Turning now to another issue, claim 12 in the parent case was rejected over Nestler in view of Gordon. That claim corresponds to claim 20 in the present case, and relates to disabling the sending of motion signals to the computer whenever the mouse is moving too fast over the work surface (e.g., during a rapid re-trace, as described in the Specification at lines 7 of page 6 through line 17 of page7). **Nothing in the prior art shows or suggests this feature.** Not so much as even a hint. We don't offer more argument, since we can't distinguish over the specifics of something that is not there. Therefore, the Examiner is respectfully requested to withdraw the rejection of claim 12 as it would apply to it successor, claim 20.

Finally, we arrive at the issues of the proximity detector and "turning the mouse off" when it is picked up, which was variously the subject matter of some previously allowed claims and is the subject matter of present claims 21 and 22. However, since the response entitled Amendment "A" was mailed, applicants have become aware of the US Patent to Scenna, (5, 894, 302, issued 13 April 1999, but filed on 28 August 1995). It is true that we can (and hereby do) at first remove Scenna as a reference under 35 USC 102(e) in this prosecution by noting that his date of issue is after our date of filing. We also note, however, that he has a relatively early date of filing, and that there may exist at least the potential for mischief under 35 USC 102(g). We therefore, and also with an eye on Rule 56, find it convenient to distinguish claims 21 and 22 over Scenna, anyhow.

The relevant portions of Scenna are element 30 of Figures 1, 2, 4,6 and 8, and 6:64 - 7:42. In brief, he describes element 30 as being principally a thumb support (7:2-5). He even suggests that it should be adjustable, and removable so that different sized pieces can be installed to better fit different thumbs (7:30-42). He also says that the element 30 can be coupled to a switch, "...preferably a two state switch ..." (7:19),

by which the subsequent text makes clear he means is more at single-pole double-throw, since he goes on to describe pressing up against 78 and down against 76 (each is part of 30) to activate desired functions. He envisions one of those functions as disengaging the mouse from the computer during repositioning (7:22-29). However, it will be noted that the last two lines of 7:22-29 are "...without lifting the housing off the work surface." It is clear that the way his switches and thumb rest 30 operate is that an upward or downward force applied to thumb rest 30 disengages the mouse.

This is in distinct contrast with the switch elements recited in claims 21 and 22:

(from 21:)

> "... a switch disposed on the skirt in a location underneath the right thumb or the left ring finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit and that inhibits the output of the motion signals to the computer system when the hand activates the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface."

(from 22:)

> "... a switch disposed on the skirt in a location underneath the left thumb or the right ring finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit and that inhibits the output of the motion signals to the computer system when the hand activates the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface."

According to what is claimed, a user is to apply to a switch a force that is parallel to the bottom surface in a manner sufficient to lift the mouse. It is recited as "squeezing." Scenna does not want squeezing, he wants the user's thumb to push up or down. He does not actually say so, but this probably requires the weight of the hand on the top of the mouse to act as counterpoise for the applied force. Whatever it is, it is not activating "... the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface" as is claimed. Especially since Scenna says at 7:26-29 that:

> "... the activation pressure for the switch is preferable selected so that the switch can be activated to disengage the mouse *without lifting the housing off the work surface*" (emphasis added).

It is true that in an earlier passage (7:6-15) Scenna describes a tilting of the mouse that uses the thumb support 30, but that maneuver is described without reference to any switches or disengaging of the mouse. And even if that maneuver were combined with the subsequently described switches, the result niether shows not suggest the claimed combination.

Therefore, claims 21 and 22 are believed to comply with 35 USC 103 in regards to Scenna.

Thus, on the basis of the arguments set out above, claims 16-22 are believed to comply with 35 USC 103, and the Examiner is respectfully, but earnestly, urged to withdraw the rejections.

THEREFORE, further examination is requested, and favorable action is respectfully solicited.

Respectfully submitted,

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